

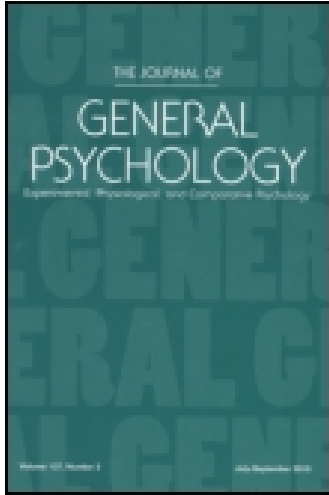
This article was downloaded by: [Central Michigan University]

On: 01 December 2014, At: 06:31

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954

Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



The Journal of General Psychology

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/vgen20>

“Resistance to Extinction” in the Process of Conditioning

B. F. Skinner^a

^a Laboratory of General Physiology, Harvard University, USA

Published online: 06 Jul 2010.

To cite this article: B. F. Skinner (1933) “Resistance to Extinction” in the Process of Conditioning, The Journal of General Psychology, 9:2, 420-429, DOI: [10.1080/00221309.1933.9920945](https://doi.org/10.1080/00221309.1933.9920945)

To link to this article: <http://dx.doi.org/10.1080/00221309.1933.9920945>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the “Content”) contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

"RESISTANCE TO EXTINCTION" IN THE PROCESS OF CONDITIONING*

From the Laboratory of General Physiology of Harvard University

B. F. SKINNER¹

We have distinguished elsewhere between the *immediately observed strength* of a conditioned reflex and its *resistance to extinction* (3). The former is evaluated from some quantitative aspect of the reflex at a given elicitation, while the latter is inferred from the properties of an extinction curve taken subsequently. There is no simple relation between them. Under repeated reinforcement, for example, a reflex will continue to develop resistance to extinction after its strength has reached an effectual maximum.

A reinforcing stimulus thus has two distinguishable effects. The traditional conditioning experiment, however, is apparently always confined to one of them—the increase in strength—probably because it is the immediately observable change. But the development of resistance to extinction is equally important. Indeed, it could be argued that extinction is the only appropriate measure of conditioning, since it is concerned with the critical defining property of the process, i.e., the presence or absence of a reinforcing stimulus. But we cannot be dealing with interchangeable measures of a single process, so long as the two "measures" behave to any extent independently, as we have seen to be the case. There are two distinct effects, and we must ignore neither of them.

Where it is desired to determine simply whether *any* conditioning has taken place or has persisted after a period of time, either change alone may suffice. Contrary to established practice, the use of the extinction curve is here usually to be preferred. In order to measure the strength of a reflex we must elicit it, and, if it is a conditioned reflex, the elicitation must be either reinforced or unreinforced. In either case there is an effect upon the state of the reflex, altering it from the condition in which we are attempting to meas-

*Accepted for publication by W. J. Crozier of the Editorial Board and received in the Editorial Office, April 28, 1933.

¹National Research Council Fellow.

ure it. This is an unavoidable dilemma, the consequences of which will be more or less serious according to the method used and the relative importance of the effect of a single elicitation. Of the special cases that arise we shall discuss a single example.

In a previous study of conditioning (2), the rate of elicitation of a reflex under continuous stimulation was used as a measure of its strength. In certain cases this was found to reach essentially a maximal value after only one elicitation of the conditioning sequence.^{1a} But in determining to what extent the change in strength is due wholly to the first elicitation, the only available "rate" is given by the interval between the first two responses, since the second elicitation contributes a further conditioning effect of its own. We need a statistical demonstration that this interval is shorter than would be observed if the first response were not reinforced. A single experiment cannot be convincing. This is unfortunate, since the amount of conditioning actually observed after one elicitation varies greatly between cases (as we shall note later) and in averaging together a group of first intervals we unavoidably obscure the exceptional examples, which are of special interest. Moreover, although a statistical demonstration in the present case does show that conditioning may take place at one elicitation, we are faced with the comparative unreliability of a single interval as a measure of the extent of the change. In such a case the use of the extinction curve is clearly indicated.

The present paper has two purposes: (1) to demonstrate the use of resistance to extinction in revealing the presence of some amount of conditioning; and (2) to confirm our earlier conclusion that for the organism and the type of reflex here considered a significant effect is definitely observable after only one elicitation of the conditioning sequence.

The apparatus and method have been described in detail elsewhere (1, 2) and the arrangements need be only summarized here. A few minor changes will be noted. The essential part of the apparatus is a small horizontal lever projecting from one wall of a sound-proof experimental box, which may be pressed downward by a rat. When this is done a magazine releases a uniform pellet of food into a convenient tray. The magazine may be disconnected

^{1a}The results given in that paper have since been confirmed with about twenty rats.

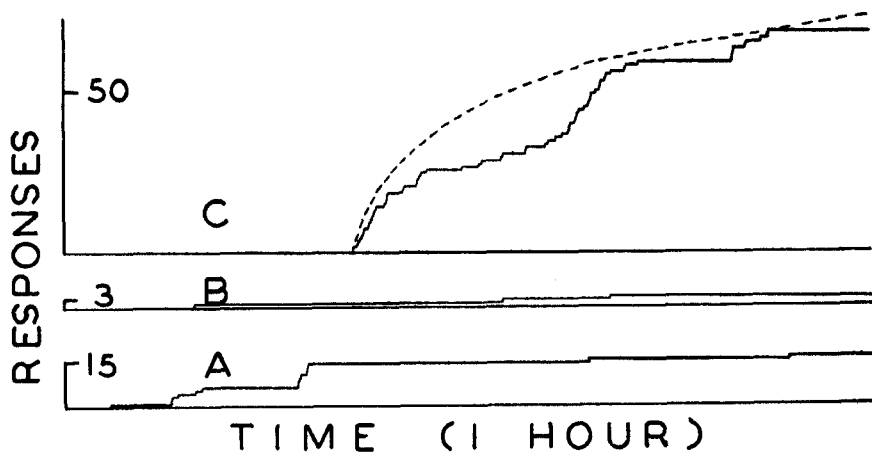


FIGURE 1

by the experimenter. The movements of the lever are recorded on a kymograph drum in the form of a summation curve. The accompanying figures are reproduced from such records, to which co-ordinates have been added.

The rat² becomes fully accustomed to the experimental box during several days on which it eats its daily ration therein. On one or more of these days the lever may be present and investigatory responses to it recorded. On three further days (the lever being absent) pellets of food are periodically delivered from the magazine by the experimenter, and during this time the rat comes to approach the tray immediately after the magazine has sounded and to seize and eat the pellet. The rat is then ready for conditioning. At the usual hour it is placed in the box. For the first time in its history, the movement of the lever will be followed by the delivery of food. *When one response has been made and reinforced, the magazine is disconnected.*

In Figure 1 the control record *A* is of investigatory responses to the lever during a preliminary training period in the absence of food. The responses fall into two groups (probably a facilitative effect) and soon adapt out quite completely. Record *B* is a control

²Albino rats of the King inbred strain are used throughout.

record of the investigatory responses in the absence of food after training to the sound of the magazine. Its significance will appear later. Record *C* was taken on the next day. The first investigatory response occurred in about 20 minutes. It was triply reinforced. That is to say, one pellet of food was discharged simultaneously with the response, and two more were discharged by the experimenter within three seconds. Although the rat received three pellets of food, *only one response was reinforced*. It will be seen from the record that the rat began to respond again immediately and during the next 40 minutes traced out a typical extinction curve. We are forced to conclude that this is the effect of the single reinforcement.³

The record has the general properties reported for extinction (3). A logarithmic envelope may be drawn above the curve (the broken line is for the equation $N = K \log t$, where N is the number of responses at time t and K is a constant), but the experimental curve suffers a cyclic deviation below it. The present example is an exceptionally good demonstration of this wave-like character, which was previously inferred from records much less regular (3). The curve differs in one respect from those obtained after more extensive conditioning: it lacks the initial burst of responses that lie upon the theoretical curve. To fit Figure 1 in this way it would be necessary to shift the origin of the theoretical curve about one minute to the right. This may indicate a lag in the effect of the conditioning.

The result is not always so clear-cut. In perhaps a majority of cases the control line *B* fails to maintain the slope to be expected from *A*. That is to say, the training to the sound of the magazine produces an increase in the observed rate of responding that is independent of any actual reinforcement with the magazine. A new base-line appears, of which the first part of the record in Figure 2 is an example. Although no reinforcement with the magazine had yet taken place, a significant rate of elicitation is evident. The extinction curve must be observed against this new base-line. At the arrow in Figure 2 a single response to the lever was reinforced with one pellet of food. After a short pause the curve of extinction was begun. Assuming that the base-line is approximately linear, we may subtract it from the experimental curve. The dotted curve

³Cf. (4), Appendix II.

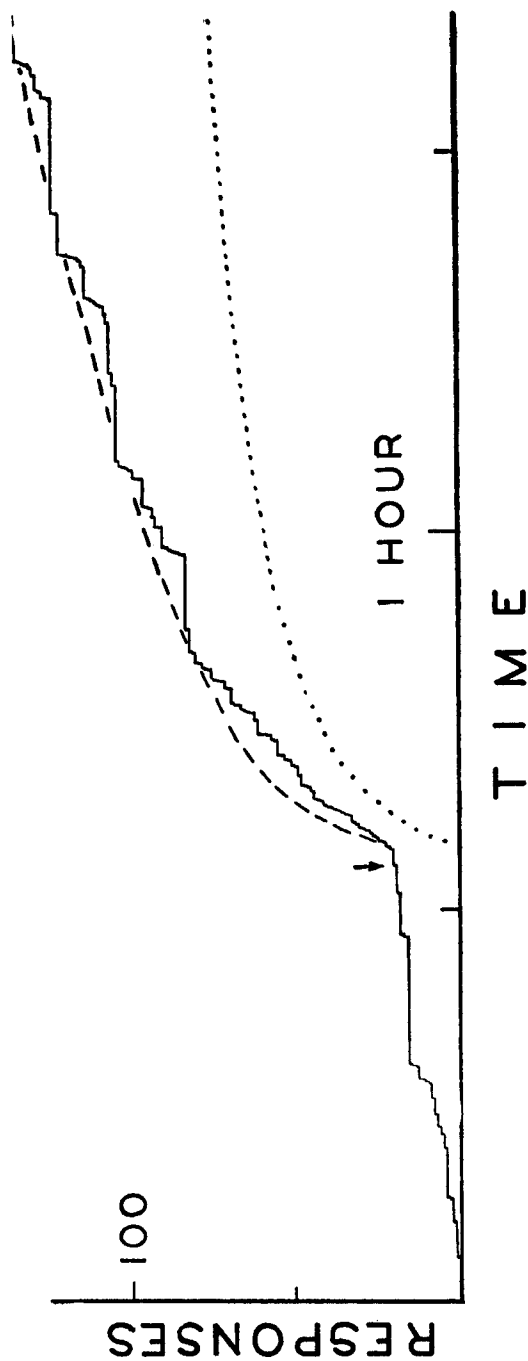


FIGURE 2

in Figure 2 is for the above equation with very nearly the same value of K . The broken line is for the same equation plus ct on the right-hand side, where c is another constant determined from the base-line. The figure thus compares very well with Figure 1, although the wave form is much less smoothly executed. Figure 2 also lacks the initial burst. The required shift in the origin would in this case be about two minutes. (It will be understood that the extinction curve begins at the first unreinforced response, not at the arrow.)

A probable explanation of the new base-line is as follows. In the preliminary training to the magazine a discrimination is established.⁴ The rat comes to respond strongly to the food-tray-plus-sound-of-magazine, but not to respond to the food-tray alone. It can easily be shown that this discrimination is frequently very broadly generalized. The rat will respond to the tray plus almost any sort of extra stimulation. Now, even though the magazine remain disconnected, a response to the lever will stimulate the rat in several ways, and this stimulation—auditory, tactual, and kin-aesthetic—may be sufficient to elicit the discriminatory response to the tray. Although no pellet is received and the sequence of reflexes therefore not eventually reinforced, the response to the lever and the discriminatory response to the tray are present, and some conditioning of the former should take place (2). This is what Pavlov has called secondary conditioning, although it should be noted that it is at least three steps removed from an unconditioned reflex.

According to this explanation, then, some conditioning may occur through generalization of the preliminary discrimination, without the reinforcement supplied by the sound of the magazine or the ultimate reinforcement with food. This view is supported by records for true secondary conditioning, where the sound of the magazine follows every response although no food is given (the magazine being empty). Figure 3 is a typical example of such an experiment. The rat had had the same preliminary training as in the other cases. On the day of the record the response to the lever was followed by the sound of the magazine and was therefore conditioned, but the response to the tray-plus-sound-of-magazine was simultaneously extinguished, since it was never followed by the delivery of food.⁵ The result is a moderate rate of responding, which varies only very

⁴For the properties of a discrimination of this sort see (4).

⁵For discussions of extinction under these conditions see (3) and (5).

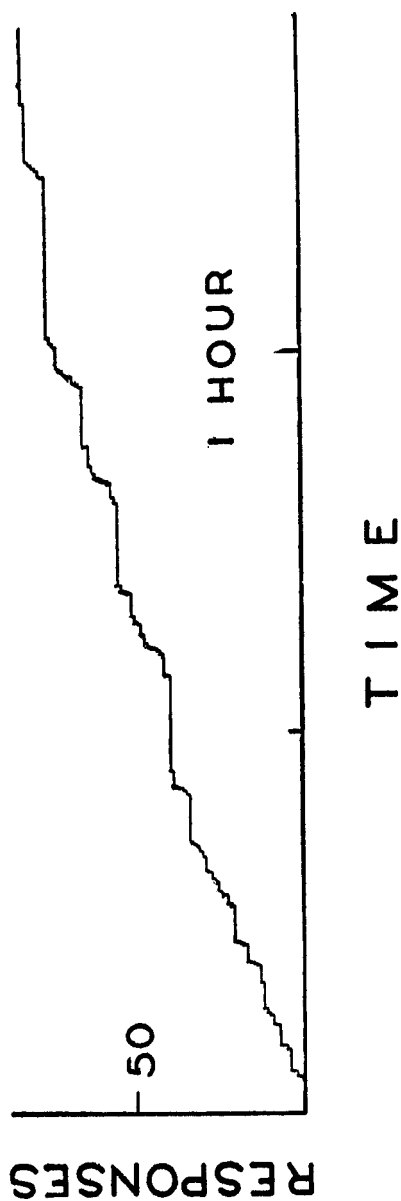


FIGURE 3

slightly during one and one-half hours, and which resembles in all essentials the modified base-line described above.

In the case of Figure 1 an adequate control against such an effect is provided by record *B*. Generalization of the discrimination has not occurred, and record *C* cannot be regarded as including a base-line of any significant slope. The curve is due wholly to the reinforcement of the first response and is not contributed to by partial reinforcement of other responses. This is obviously the simpler result, and some way should be devised to obtain it regularly. Although there is no insuperable difficulty in accounting for the effect of generalization, it is for certain purposes objectionable. The conditioning that occurs at the arrow in Figure 2, for example, is not *original* conditioning if our interpretation of the preceding base-line is correct.

It is evident that the extinction curve supplies considerable definite information about the change occurring at reinforcement. So far as resistance to extinction alone is concerned, some aspect of the curve (its height or area) is a proper measure of the *amount* of conditioning. In the present type of experiment, with a single reinforcement, this amount varies considerably among rats. The curves in Figures 1 and 2 are somewhat larger than the average, although they are by no means exceptional. In rare cases no effect may be detectable. "Good" records cannot, of course, be accidental. On the other hand, we have already noted several reasons why a first reinforcement may not be fully effective (2, p. 282). These sources of variability seem for the moment to be beyond our experimental control.

SUMMARY

Two changes occur during the formation of a conditioned reflex: an increase in the immediately observed strength of the reflex, and an increase in its resistance to extinction. In many cases the latter is a preferable measure of the presence or absence of an effect.

The reinforcement of a single response may be followed by a significant curve of extinction. The curve serves as a measure of the amount of conditioning taking place. A complicating change sometimes observed in the rate of elicitation prior to specific reinforcement is described and discussed. The effect of a single reinforcement is still readily observable. In explaining the change, a record for secondary extinction (simultaneous conditioning and extinction) is described.

REFERENCES

1. SKINNER, B. F. Drive and reflex strength: I. *J. Gen. Psychol.*, 1932, **6**, 22-37.
2. ———. On the rate of formation of a conditioned reflex. *J. Gen. Psychol.*, 1932, **7**, 274-286.
3. ———. On the rate of extinction of a conditioned reflex. *J. Gen. Psychol.*, 1933, **8**, 114-129.
4. ———. The rate of establishment of a discrimination. *J. Gen. Psychol.*, 1933, **9**, 302-350.
5. ———. The abolishment of a discrimination. *Proc. Nat. Acad. Sci.* (in press).

*Laboratory of General Physiology
Harvard University
Cambridge, Massachusetts*

"LA RÉSISTANCE FAITE À L'EXTINCTION" DANS LE PROCESSUS
DE CONDITIONNER

(Résumé)

Il se montre deux changements pendant la formation d'un réflexe conditionnel: un accroissement de la force immédiatement observée du réflexe, et un accroissement de la résistance qu'il fait à l'extinction. Dans plusieurs cas la dernière est une mesure préférable de la présence ou de l'absence d'un effet.

Le renforcement d'une seule réponse peut être suivi d'une courbe significative d'extinction. La courbe sert comme mesure de la quantité de conditionnement qui a lieu. On décrit et discute un changement de complication quelquefois observé dans la vitesse de l'apparence de la réponse avant un renforcement spécifique. L'effet d'un seul renforcement peut toujours être observé facilement. Dans l'explication du changement, on décrit une notation de l'extinction secondaire (le conditionnement et l'extinction en même temps).

SKINNER

"WIDERSTAND GEGEN AUSLÖSCHUNG" IN DER ERSTELLUNG
BEDINGTER REFLEXE

(Referat)

Zwei Veränderungen treten während der Erstellung eines bedingten Reflexes auf: eine Zunahme in der unmittelbar beobachteten Stärke des Reflexes und eine Zunahme des Widerstandes gegen die Auslöschung. In manchen Fällen ist dieser ein zu bevorzugendes Mass für das Auftreten oder Fehlen einer Wirkung.

Der Verstärkung einer einzelnen Reaktion kann eine bedeutsame Auslöschkurve folgen. Die Kurve dient als Mass der stattgefundenen Erstellung eines bedingten Reflexes. Die vorliegende Arbeit beschreibt und

diskutiert eine komplizierte Veränderung die gelegentlich in den Angaben einer Erstellung vor einer spezifischen Verstärkung zu beobachten ist. Die Wirkung einer einzelnen Verstärkung kann noch leicht beobachtet werden. Bei der Erklärung der Veränderung wird eine Aufzeichnung für sekundäre Auslöschung (simultane Erstellung bedingter Reflexe und Auslöschung) beschrieben.

SKINNER